HABITAT USE AND POPULATION DENSITY OF PROBOSCIS MONKEYS *(Nasalis larvatus)* AT SAMUNSAM WILDLIFE SANCTUARY, SARAWAK

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Bachelor of Science with Honours
(Animal Resource Science and Management)
2005

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This project is submitted in partial fulfilment of the requirements for the degree of
Bachelor of Science with Honours
(Animal Resource Science and Management Programme)

Faculty of Resource Science and Technology
UNIVERSITI MALAYSIA SARAWAK
2005

DECLARATION

No portion of the work referred to in this dissertation has been submitted in support of an application for another degree of qualification of this or any other university or institution of higher learning.

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ACKNOWLEDGEMENT

First of all, I would like to thank Almighty God for His mercy and grace that sustained me all my life. I would like to express my sincere gratitude and appreciation to Assoc. Prof. Dr. Andrew Alek Tuen for his constant guidance, counsel, and supervision throughout the completion of this thesis. Without his perseverance and leadership, the success of this thesis would not be achieved.

I would also like to thank Sarawak Forestry Department for the permit to carry out this study at Samunsam Wildlife Sanctuary. I am also grateful to Sarawak Forestry Corporation for providing free accommodation throughout this study. I would like to thank the wildlife rangers of Samunsam Wildlife Sanctuary, Mr. Reming ak. Runyed and Mr. Jedel b. Hj. Mahli for their valuable assistance and providing useful information in this study. Not forgetting to appreciate the efforts and willingness of Mr. Ali Ahmad b. Mat as the boat driver. Additionally, this study was also supported with the help of Mr. Japri b. Senan and Mr. Ridzuan b. Anuar as the guides.

Furthermore, I have been benefited through the special contributions from my peers and colleagues whose support and advice does make a difference. Finally, I would like to dedicate the success of this thesis to my parents, Mr. George Pandong and Mdm. Mary Giman for their continuous prayers, support and encouragement throughout my endeavour.

This research was carried out under the UNIMAS Fundamental Research Grant no. 273/2002(11).

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ABSTRACT

A research was conducted at Samunsam Wildlife Sanctuary during the month of August and November 2004 to study the habitat use and population density of proboscis monkeys (*Nasalis larvatus*). Results indicated that there were distinct differences in the range of habitat use between August and November 2004 with the abrupt expansion from 0.5 km in the month of August to 3 km of different habitat types used in November. The major type of habitat utilized by proboscis monkeys was the mangrove forest. A mixture of mangrove, mixed dipterocarp and tropical heath forest were also used during both seasons. Towards November 2004, the tropical heath-riverine forest habitat was utilized as a result of higher availability of young leaves during this season. Comparison of proboscis monkey density sightings between August and November 2004 showed a distinct difference with only 0.08 groups/ km surveyed in August compared with 0.27 groups/ km surveyed during November 2004. Sightings of individual density showed 0.48 individuals/ km surveyed in the month of August whereas 1.34 individuals/ km surveyed in November 2004. Chi-square (χ^2) test was calculated and showed that there were significant differences ($p < 0.05$) between both seasons in the no. of group and individual sighted. Sightings of proboscis monkeys were probably influenced by food availability and competition for food resources.

Key words: *Nasalis larvatus*, Samunsam Wildlife Sanctuary, habitat use, population density, food availability.

ABSTRAK

Sebuah kajian telah dijalankan di Sanktuari Hidupan Liar Samunsam pada bulan Ogos dan November 2004 untuk mengkaji penggunaan habitat dan kepadatan populasi orang belanda (Nasalis larvatus). Keputusan menunjukkan terdapat perbezaan yang ketara dalam julat penggunaan habitat antara Ogos dan November 2004 dengan peluasan secara mendadak daripada 0.5 km pada bulan Ogos kepada 3 km habitat yang pelbagai jenis pada bulan November. Jenis habitat utama yang digunakan oleh orang belanda adalah hutan paya bakau. Suatu campuran hutan paya bakau, dipterokarp campuran dan kerangas tropika turut digunakan pada kedua-dua musim. Menuju November 2004, habitat hutan kerangas tropika-persisiran sungai digunakan hasil daripada keberadaan daun muda yang lebih tinggi pada musim ini. Perbandingan antara kepadatan kumpulan orang belanda yang diperhatikan antara Ogos dan November 2004 menunjukkan perbezaan yang ketara dengan hanya 0.08 kumpulan/ km pemantauan ketika bulan Ogos dibandingkan dengan 0.27 kumpulan/ km pemantauan ketika bulan November 2004. Pemerhatian kepadatan individu menunjukkan 0.48 individu/ km pemantauan pada bulan Ogos yang mana 1.34 individu/ km pemantauan pada November 2004. Ujian Chi-kuasa dua (χ^2) telah dikira dan menunjukkan bahawa terdapat perbezaan yang signifikan ($p < 0.05$) antara kedua-dua musim dalam bilangan kumpulan dan individu yang diperhatikan. Pemerhatian orang belanda kemungkinan dipengaruhi oleh keberadaan makanan dan persaingan untuk sumber makanan.

Kata kunci: Nasalis larvatus, Sanktuari Hidupan Liar Samunsam, penggunaan habitat, kepadatan populasi, keberadaan makanan.

1.0 INTRODUCTION

Proboscis monkeys (*Nasalis larvatus*) can only be found in the island of Borneo, but they do not live throughout the island. They are only limited mainly to coastal swamp forests and to forests next to large rivers. These coastal swamp forests mainly consist of mangrove and peat swamp forests (Bennett & Gombek, 1993). However, it is unwise to assume that proboscis monkeys occupy any area of mangrove or peat swamp forest. Their habitat depends on the different zones where different types of trees are used for foraging or sleeping. Small numbers are sometimes found further inland next to major rivers. This is because they are likely to live in forests that grow on nutrient-rich alluvial soils such as mangroves or alongside rivers where sufficient supply of digestive food are available (Bennett & Gombek, 1993).

The pattern of daily habitat use is determined by two main factors, which are the location of good food sources and rivers. Proboscis monkeys return to their trees next to the river every single night (Bennett & Gombek, 1993). Trees used for sleeping are generally tall and fairly open for better visibility. This is presumably allows the animals to stay alert for predators as well as to provide a good view of the best places for foraging in the morning. After dawn, they will move from their sleeping habitats to forage into the forest away from the river. Their food is often scarce and scattered; therefore, they need to travel much further in long distances to find enough food sources to survive. Therefore, much of their activity time will be spent alternating between feeding, resting and travelling (Bennett & Gombek, 1993).

Despite their endemic status, proboscis monkeys are facing pressures as a result of illegal hunting and loss of their habitat caused by humans (Rubis, 2001). Research proves that proboscis monkeys do not generally do well in captivity. They are extremely selective feeders and because of poor captive diets, their delicate digestive system would be stressed and this would eventually result in death (Bennett & Gombek, 1993). Therefore, with the alarming threats and ineffectiveness of *ex-situ* conservation measures, proboscis monkeys must be protected with *in-situ* approach.

Most researches carried out at Samunsam Wildlife Sanctuary were done back in the mid-1980s and early 1990s (e.g. Bennett & Sebastian, 1988). The latest research was conducted by Rubis from October 2001 to September 2002 (Rubis, undated). Based on Rubis' works, the pressures posed by humans were the main reason of the population decline. The decline may have influenced their habitat use between then and now. Moreover, if habitat characteristics of the proboscis monkeys have changed in recent years, then it may affect their behaviour as well. Thus, data collected through this research can be used to compare with data from similar studies done by other researchers as well as updating observation data done by Rubis.

The present study is initiated in order to determine the habitat use by proboscis monkeys during August and November 2004 and to estimate the population density sighted along Samunsam River. This is carried out in order to support and revise the current information available at Samunsam Wildlife Sanctuary, as well as to provide basic information, which is useful for the *in-situ* conservation of proboscis monkeys.

2.0 LITERATURE REVIEW

The study area for this research is at Samunsam Wildlife Sanctuary. Samunsam is the oldest wildlife sanctuary in Sarawak and is located at the western tip of Sarawak (1° 78' N, 109 ° 36' E) (Bennett & Sebastian, 1988). In 1979, it was gazetted with the fundamental objective of protecting proboscis monkeys and they are probably the largest known protected population in Sarawak, with approximately 150 individuals (Rubis, undated).

Most researches on proboscis monkeys in Samunsam Wildlife Sanctuary were done during the mid-1980s and early-1990s. Among them are Bennett & Sebastian (1988), Rajanathan & Bennett (1990), Bennett & Gombek (1993), Bennett & Davies (1994), Rubis (2001 & undated) and their associates. There are other researchers who had done their study on proboscis monkey throughout the island of Borneo. Among them are Yeager (1989 & 1995) and Yeager *et al.* (1997) who conducted their research at Tanjung Puting National Park, Kalimantan Tengah, Indonesia and Boonratana & Sharma (1992) as well as Boonratana (2000) who conducted a few studies in the Lower Kinabatangan, Sabah. Although their research may not be similar in terms of study sites, study discipline, objectives and methodology, yet the information that they had provided has been a great contribution to other subsequent studies, such as in the field of habitat utilization.

According to Salter *et al.* (1985), habitat use refers to the preferred habitat to be used significantly for feeding, moving, resting and other related activities. Therefore, in the present study, habitat use by proboscis monkeys observed includes the sleeping location, foraging sites and food-related travel activities.

Among the first research done on proboscis monkeys in Sarawak that includes Samunsam Wildlife Sanctuary was carried out by Salter *et al.* (1985). They found out that groups of proboscis monkeys were recorded in a variety of riparian and coastal habitats. Areas around human settlements were completely avoided, although some were seen to use selectively felled tidal forests, remnant tidal forests adjacent to agricultural land and logged high forest. Salter *et al.* (1985) also reported that the proboscis monkeys slept primarily along river edges, moving inland up to 750 m during the day and returning to the riverside in late afternoon. They also observed proboscis monkeys feed on at least 90 plant species, including leaves or shoots, fruits, seeds and flowers.

The research done by Bennett & Sebastian (1988) and Bennett & Davies (1994) found out that *N. larvatus* were highly selective feeders, travelling directly between food sources, even if they were widely spaced. They were also being selective with the food that they eat prefering young leaves, fruit stalks and seeds of certain plants.

The minimum average day-range of proboscis monkeys is more than 706 m as the distance observed is only between sleeping sites (Bennett & Davies, 1994), thus, the actual average day range is likely to be much longer (up to 2000 m). Their home-range area was estimated to be 900 ha at Samunsam. However, the population density and biomass of proboscis monkeys in Samunsam was low (0.52 group/ km^2 and 46 kg/ km^2) compared to other colobine monkeys, such as *Presbytis rubicunda* at Sepilok, Sabah that has a population density of 2.7 groups/ km^2 and a biomass of 49 kg/ km^2. Illegal hunting was assumed to be the

reason for the low population density and their wide-ranging behaviour were an indication that food availability was low at coastal forests (Bennett & Sebastian, 1988).

Another research was done on the study of social behaviour of proboscis monkeys at Samunsam Wildlife Sanctuary by Rajanathan & Bennett (1990). The study found out that all mixed-sex groups were harems with the average group size of nine. All-male groups were also recorded. However, in terms of spatial distance, harems were spatially cohesive than the more scattered all-male groups. They also noted that harems change their composition frequently, with both females and males switching between groups. Other observations include group movements which were observed to be led by the females and not the male.

In Boonratana & Sharma's (1992) research, they observed population of proboscis monkeys to be at least 750-830 individuals during 1990 and 1991. The main group at Sukau used an area more than 220 ha and travelled at least 600 m away from the Kinabatangan and Menanggul Rivers in search of food. However, it was observed that much larger area that was used as full-day tracks were unsuccessful.

Boonratana & Sharma (1992) encountered many setbacks in conservation measures taken around their study areas. Among the major setback was proboscis monkeys protected in a particular area were found outside the reserve.

Boonratana (2000) made a follow up on his research and made some interesting findings. The result of the research shows that a negative correlation existed between vigilance and day range length. There were also no daily correlations between vigilance activity and food items in the diet. However, there was a significant positive correlation between vigilance and flowers in diet. This proposes that proboscis monkeys in a one-male group (SU1) increased their vigilance to locate rare food items. The opposite result was shown between vigilance and fruits (including seeds) in the diet. Boonratana (2000) suggested "they spent less time at vigilance when there were more fruits in their diet, probably to maximise feeding on rare food items". Boonratana (2000) also found out that members of one-male group in Sukau spent approximately 27.8% of their annual activity budget in vigilance while members at Abai study area spent 30%.

Yeager (1989) provided information on the feeding ecology of proboscis monkeys at Natai Lengkuas Station, Tanjung Puting National Park, Kalimantan Tengah Indonesia. She found out that proboscis monkeys utilizes 55 different plant species, of which the three most important species used were *Eugenia* sp., *Ganua motleyana* and *Lophopetalum javanicum*. However, Yeager (1989) also recorded that proboscis monkeys were selective feeders and do not feed simply based on relative density. They tend to switch dietary strategies and increased dietary diversity during times of low food abundance. Other observations by Yeager (1989) include the total home range was estimated to be 130.3 ha, an average group density of 5.2 groups per km^2 and the average biomass per km^2 was estimated to be 499.5 kg at Natai Lengkuas.

On the other hand, Yeager *et al.* (1997) provided much detailed research on diet and foliage selection of proboscis monkeys. Samples were collected and analyzed on two different periods in the year 1985 and 1992 at Tanjung Putting National Park. Their research proved that diet selection was not only based on the relative availability of food items but also in its quality. It was found that leaves consumed by proboscis monkeys are relatively higher in protein, lower in fibre and contain significantly higher concentrations of phosphorus and potassium.

Another study conducted by Nijboer *et al.* (undated) further explained the functions and purposes as to why proboscis monkeys and other colobines prefer this type of diet. According to Nijboer *et al* (undated), apart from sustaining normal digestive physiology, it is a necessity to provide "a suitable diet for supporting pregastric fermentation for microbial degradation of plant cell wall constituents as an energy source". In return, suitable microbial populations contribute important detoxification mechanisms for coping with secondary compounds identified in leaves and seeds consumed in nature. They also added "both excessive soluble carbohydrates and protein concentrations in diets fed to captive colobines have implicated in health disorders".

Rubis (undated) conducted a more recent study during the period of October 2001 till September 2002 at Samunsam Wildlife Sanctuary to estimate current primate abundance. Preliminary report from the observation shows surprising and alarming results. Even with high abundance of food supply, proboscis monkeys were observed actively foraging in mixed dipterocarp secondary forests (behind the sanctuary's headquarters), which are habitats where no earlier presence was recorded in the sanctuary (Rubis, 2001).

Rubis (2001) stated that proboscis monkeys rarely spend the night on riverbanks in recent time period. Furthermore, Rubis observed that fewer groups of proboscis monkeys have been observed by the river during evening counts compared to ten years ago. The change of behaviour may well be the results of more illegal human activities such as land clearing and illegal hunting. This poses a very alarming threat that would potentially influence population density. Therefore, proboscis monkeys may travel further inland to ensure their safety and provide extra protection from poachers (Rubis, undated).

3.0 MATERIALS AND METHODS

3.1 Study Site

Samunsam Wildlife Sanctuary has a wide range of habitats. The four main forest types in the area are mangrove, riverine, mixed dipterocarp and tropical heath forest (Bennett & Sebastian, 1988) (see Fig. 1).

Mangrove forest covers about 5 km upriver along the lower reaches of Samunsam River (Rubis, 2001). *Rhizophora* sp. is the dominant plant species with patches of common mangrove trees that include *Avicennia* sp. and *Sonneratia* sp. can be seen growing by the riverbanks. These in turn are replaced by *Bruguiera* sp. and nipa palms (*Nypa fruticans*) towards upper reaches to form a mangrove-nipa forest, approximately 4-6 km from the mouth of the river (Bennett & Sebastian, 1988).

Riverine forest spreads mainly along the upper reaches of the Samunsam River (Rubis, 2001). The forest occurs patchily throughout the area and consists of *Shorea* sp., *Vatica* sp., *Eugenia* sp. and *Tristania* sp. as the common tree genera (Bennett & Sebastian, 1988). Rattans (*Calamus* sp.) are abundant at the usually dense undergrowth. Clusters of nibong palms (*Oncosperma tigillarium*) are also found in riverine forest along Samunsam River (Rubis, 2001).

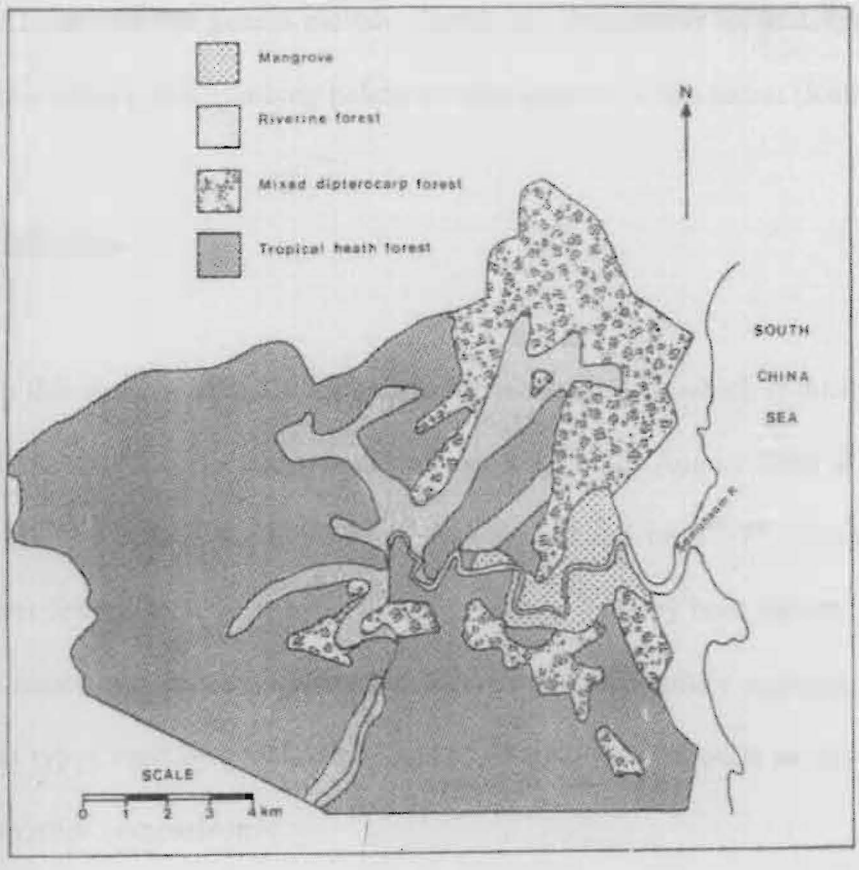


Fig. 1. Distribution of forest types at Samunsam Wildlife Sanctuary, Sarawak (adapted from Bennett & Sebastian, 1988)

Tropical heath forest is the most widespread forest type as it covers area away from the shore and rivers (Bennett & Sebastian, 1988). However, it does occur in patches with other forest types along Samunsam River. Among the common tree genera found in this type of forest are *Shorea* sp. and *Palaquium* sp. The trees grow on soil that consists of a thick layer of grey-humus stained sand underlying a layer of quartz sand (Rubis, 2001).

Mixed dipterocarp forest has the most diverse plant species of all the forest types in the sanctuary and consists of tall, broad and heavily buttressed trees (Rubis, 2001). Among the common tree families include Dipterocarpaceae, Euphorbiaceae, Moraceae, Sapotaceae and

Anacardiaceae. Common tree genera include *Shorea* sp., *Artocarpus* sp. and *Aporusa* sp. with a variety of non-climbing and climbing palms are also present in this forest (Rubis, 2001).

3.2 Data Collection

Data for this study were collected at two different periods, which is during the dry and wet season. The first data collection was carried out on 8th-12th August 2004 to represent dry season data while the second data collection was carried out on 3rd-7th November 2004 to represent the wet season data. Data collection was mainly done by boat surveys. This method provided information on the comparison between proboscis monkey sightings, comparison between habitat types used by proboscis monkeys, density of proboscis monkeys as well as habitat characteristics comparison.

3.2.1 Boat Survey

Boat surveys were done along the Samunsam River and timed carefully at dawn (5:30am – 7.30am) and dusk (6:30pm – 8:30pm) to observe the proboscis monkey sleeping sites. When there was a proboscis monkey sighting, the boat was slowed down to a halt. This was to enable observation done using binoculars and the naked eye on the group size, observed number of adult, juvenile, male and female in the group. The characteristics of habitat used by proboscis monkeys were also recorded. Characteristics include habitat types, types of terrain (e.g. hilly, flooded, flat or swamp etc), plant species used, and height of plants (above ground). A mobile GPS unit, Garmin eTrex™ Vista was used to record the position of proboscis monkeys. Other relevant observations were also noted down.

3.3 Data analysis

Analysis of data was done on the density of proboscis monkeys sighted per kilometre. The formulas used were as below:

$$Group\ density = \frac{Total\ no.of\ groups\ sighted}{Total\ km\ surveyed}$$

$$Individual\ density = \frac{Total\ no.of\ individuals\ sighted}{Total\ km\ surveyed}$$

$$Total\ km\ surveyed = Length\ of\ river\ transect\ surveyed\ (km) \times Frequency\ of\ boat\ surveys$$

Besides that, Chi-square (χ^2) test was also calculated to compare the frequency of proboscis monkey sightings between August (dry season) and November (wet season) 2004. The formula and hypotheses used are as below:

$$\chi^2 = \sum \frac{(Observed - Expected)^2}{Expected}$$

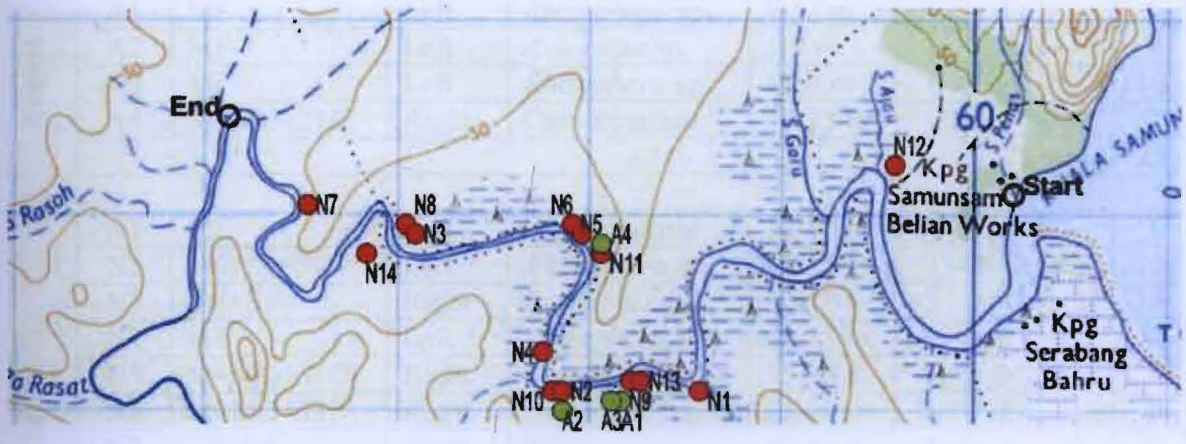
H_0= There is no difference between no. of groups or individuals of proboscis monkeys sighted during both seasons

H_a= There is a difference between no. of groups or individuals of proboscis monkeys sighted during both seasons

4.0 RESULTS

4.1 Comparison between August and November 2004 sightings of proboscis monkeys at Samunsam Wildlife Sanctuary, Sarawak

Referring to Figure 1, there were distinct differences between the range of habitat use between August and November 2004. In August, there was only about 0.5 km of habitat use compared to a range of 3 km in November.



Legend:

- Proboscis monkeys sighted in August 2004
- Proboscis monkeys sighted in November 2004

Fig. 2. Map showing the start and end point of the boat survey conducted as well as sightings of proboscis monkeys in Aug. and Nov. 2004

4.2 Summary of proboscis monkey sightings for August and November 2004

There were a total of six boat surveys conducted for each trip during August and November 2004. The information from the boat surveys is summarized in Table 1.

Table 1. The summary of proboscis monkey sightings, habitat use and group size for August and November 2004

SIGHTINGS		HABITAT USE				GROUP SIZE			
Month (2004)	**Group Label**	**Type of habitat**	**Side of river**	**Tree(s) used for sleeping**	**Approx. height**	♂	♀	**Juve.**	**Total**
August	A1	MF	Left	*Rhizophora* sp.	9-12 m	1	4	-	5
	A2	MF	Left	*Avicennia* sp.	5-9 m	1	2	-	3
	A3	MF	Left	*Rhizophora* sp.	6-10 m	1	≥ 5	N.D.	10
	A4	M+MD+THF	Right	Casuarinaceae	10-15 m	1	4	2	7
								Total:	25
November	N1	MF	Left	Casuarinaceae	12-15 m	1	2	-	3
	N2	MF	Left	*Rhizophora* sp.	12-15 m	3	N.D.	N.D.	12
	N3	TH+RF	Right	Casuarinaceae	10-15 m	3	N.D.	N.D.	10
	N4	MF	Left	*Rhizophora* sp.	12-15 m	1	2	1	4
	N5	M+MD+THF	Right	Casuarinaceae	15-20 m	1	3	1	5
	N6	M+MD+THF	Right	*Dipterocarpus* sp.	15-20 m	1	2	1	4
	N7	TH+RF	Right	N.D.	17-20 m	1	3	2	6
	N8	TH+RF	Right	N.D.	15-20 m	3	2	-	5
	N9	MF	Left	*Rhizophora* sp.	12-15 m	1	-	-	1
	N10	MF	Left	*Avicennia* sp.	5-9 m	1	-	-	1
	N11	M+MD+THF	Right	*Dipterocarpus* sp.	15-20 m	1	3	2	6
	N12	MF	Left	*Rhizophora* sp.	9-12 m	-	2	-	2
	N13	MF	Left	*Rhizophora* sp.	12-15 m	2	3	2	7
	N14	TH+RF	Left	Casuarinaceae	10-15 m	1	2	1	4
								Total:	70

MF = Mangrove forest
M+MD+THF = Mangrove + Mixed dipterocarp + Tropical heath forest
TH+RF = Tropical heath + Riverine forest
N.D. = Not determined

4.3 Comparison between the types of habitat used by proboscis monkeys in August and November 2004

There are four main types of habitat along Samunsam River (see Figure 3 and Table 2). Some of the habitats are a mixture of different forest with patches of common tree genera seen growing along with other trees from different types of habitat (refer to 3.0 Study Site for further details of forest types).

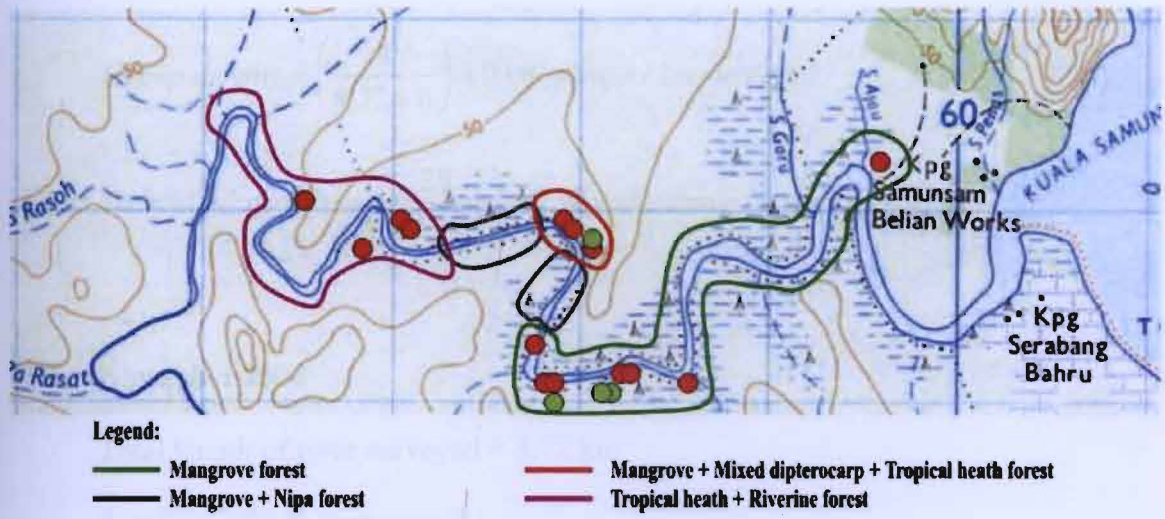


Fig. 3. Map showing the types of habitat along Samunsam River

Table 2. The number of proboscis monkey groups using the different types of habitat in Aug. and Nov. 2004

No. of groups in: / Types of habitat	Aug. 2004	Nov. 2004
Mangrove forest	3	7
Mangrove + Nipa forest	0	0
Mangrove + Mixed dipterocarp + Tropical heath forest	1	3
Tropical heath + Riverine forest	0	4
Total no. of groups:	4	14

4.4 Population density of proboscis monkeys per kilometre (km) surveyed

a. August 2004

Total length of river surveyed = 8.72 km

Total no. of boat surveys = 6

No. of group sighted = 4

No. of individual = 25

$$Group\ density = \left(\frac{4}{8.72 \times 6}\right) = 0.08\ groups / km\ surveyed$$

$$Individual\ density = \left(\frac{25}{8.72 \times 6}\right) = 0.48\ individuals / km\ surveyed$$

b. November 2004

Total length of river surveyed = 8.72 km

Total no. of boat surveys = 6

No. of group sighted = 14

No. of individuals sighted = 70

$$Group\ density = \left(\frac{14}{8.72 \times 6}\right) = 0.27\ groups / km\ surveyed$$

$$Individual\ density = \left(\frac{70}{8.72 \times 6}\right) = 1.3379\ individuals / km\ surveyed$$

4.5 Results of Chi-square (χ^2) test

Chi-square (χ^2) test was used to compare the sighting frequency between August and November 2004.

Table 3. Chi-square (χ^2) test calculations of difference between no. of groups and individuals of proboscis monkeys sighted during Aug. and Nov. 2004

	MONTHS (SEASON) 2004		SIGNIFICANCE
	August (dry)	November (wet)	
No. of groups:	4	14	$p < 0.05$
No. of individuals:	25	70	$p < 0.05$

Chi-square (χ^2) test showed that there was a significant difference between dry and wet season in the no. of groups and no. of individuals of proboscis monkeys sighted along Samunsam River. Therefore, we reject the null hypothesis (H_o) and accept the alternative hypothesis (H_a).